INTRODUCTION

Colloidal silica or coagulated silica gel (Aerosil Figure 1) has been successfully used to increase viscosity and impart thixotropic character to lipophilic ointments, non-aqueous suspensions and pharmaceutical or cosmetic gels. These effects are due to the formation of a three-dimensional network between the colloidal silica particles via hydrogen bonding thus imparting paste-like consistency especially with oils such as peanut oil, silicone oil, isopropyl myristate and other oils depending on the polarity of the oil. For example suspensions of silica in oils are thixotropic showing a gradual increase on storage due to the formation of network as shown in Figure 2. When mechanical stress is applied (e.g. rubbing of a gel on the skin surface), the three-dimensional network will break down and with passage of time regains its consistency under static condition. In the presence of polymers, an additional mechanism complements the thixotropic property of the system. The polymer chains may show variety of conformations and adsorb at the surfaces of all particles in the system including colloidal silica (Figure 3).

OBJECTIVES

To identify extent of rigourousness via texture analysis, adhesion and viscosity in a three-dimensional gel network of a 1% diclofenac sodium topical gel when adding colloidal silica and assessing its spreadability and performance upon application to the forearm of human subjects.

RESULTS

The texture analysis profile using cone-cap assembly indicates that a linear increase in viscosity with corresponding increases in rigourousness and spreadability at levels ≥2% to ≤5% w/w silica dispersed in the gel ensues (Figure 5, 6). The viscosity increase as a function of time after dispersing the colloidal silica into the gel is shown (Figure 7). Performance assessment by using standard 1% gelic topical gel as reference showed that inclusion of silica significantly enhanced adhesiveness and resistance to rub off, with an increase capacity for occlusion by formation of a thin continous film on the skin (Figure 10). Application of silica containing gels was comparable to that of standard gel in terms of subject compliance and comfort based on the subjective assessment scale. Results also illustrated an increase in viscosity for mixture of mineral oil and colloidal silica and the mixture of 1% carbopol solution and colloidal silica were also investigated using a high performance rotational viscometer.

CONCLUSIONS

Changes in the gel formulation with the addition of silica appears to enhance viscosity and adhesiveness to the skin with potential for occlusion, which may enhance drug penetration into the skin. It also allows for reduction in application frequency and consequently improve patient compliance. The composition of the system allows for significant silica-silica hydrogen bonds mediated by the collective interaction of non-polar and polar constituents of the gel matrix, thus increasing viscosity and imparting thixotropic properties to the dispersed system. Viscosity of silica-mineral oil mixture increased exponentially. These findings may help formulators to have additional options to develop a more robust and malleable product.

REFERENCE

[2] Evonik Degussa’s Technical Information No. 1281, AEROSIL® Colloidal Silicon Dioxide for Pharmaceuticals
[3] Evonik Degussa’s Technical Bulletin No. 54, AEROSIL® fumed silica in unsaturated polyester resins and vinyl ester resins